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(71) Applicant
Pall Corporation

(Incorporated in the USA – New York)

2200 Northern Boulevard, East Hills, New York, New York 11548, United States of America

(72) Inventor
James T Connors Jr

(74) Agent and/or Address for Service
Mathisen Macara & Co
The Coach House, 6–8 Swakeleys Road, Ickenham, Uxbridge, Middlesex, UB10 8BZ, United Kingdom

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(54) Filter for an aggressive fluid

(57) A filter for an aggressive fluid such as a hot sulphuric acid or solvent-based printing ink includes two housing sections (10, 30) made of a material resistant to the aggressive fluid. The housing sections are combined to define a chamber enclosing a filter element 61, and a seal member 62 forms a fluid-tight seal between the housing sections and clamps the filter element in place round its periphery. A plastic overmold 50, made of a material which need not be resistant to the aggressive fluid, secures the housing sections together with seal member 62 under pressure. Interlocking formations on the housing sections prevent relative rotation.

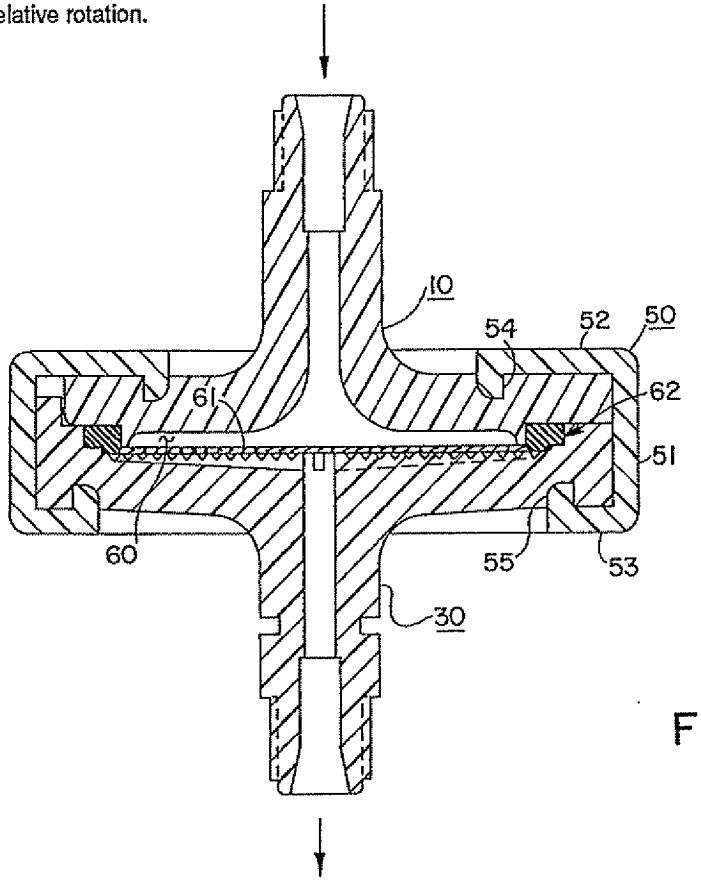

FIG. 1

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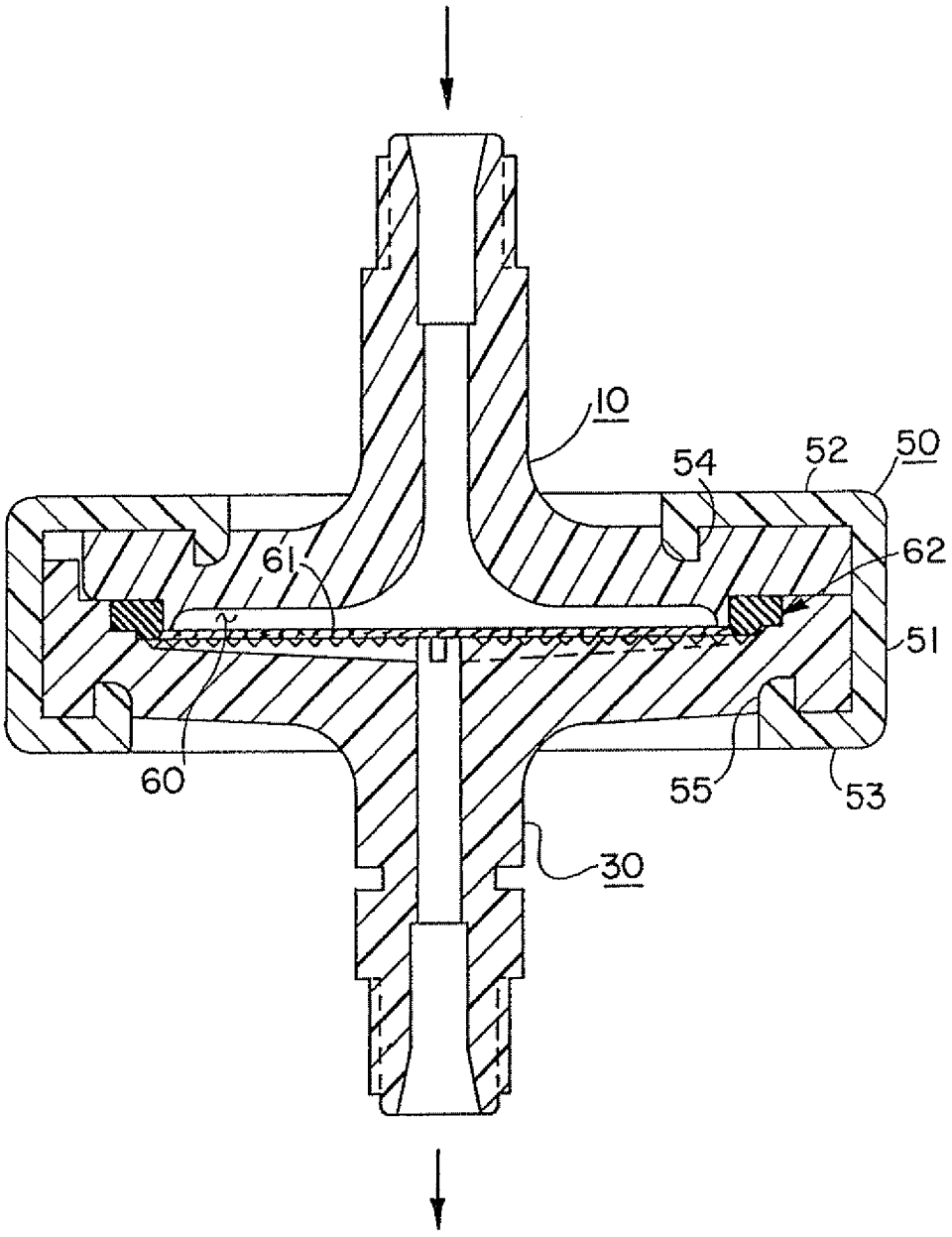
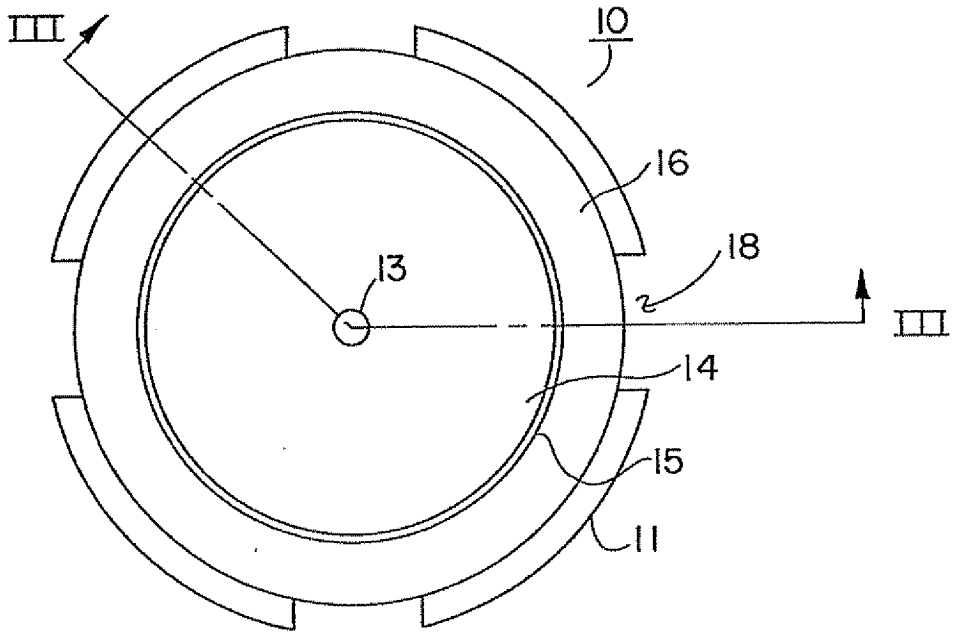


FIG. 1

FIG. 2



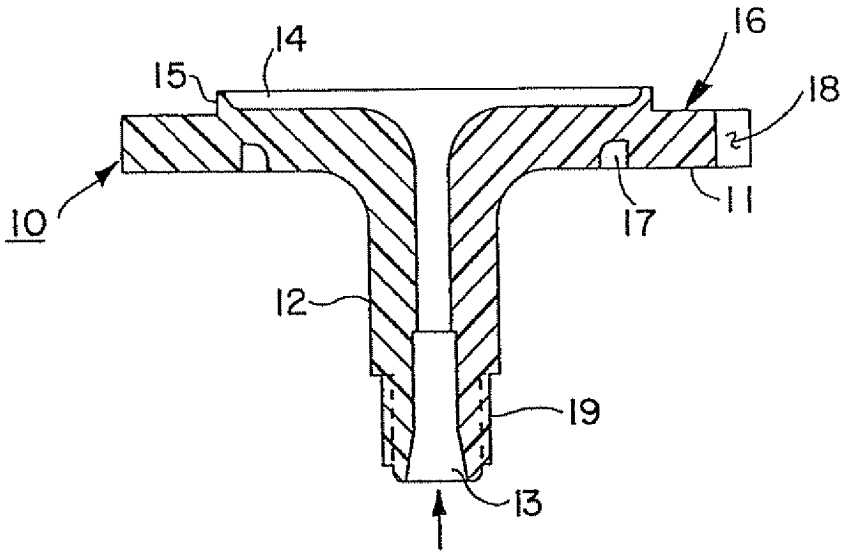
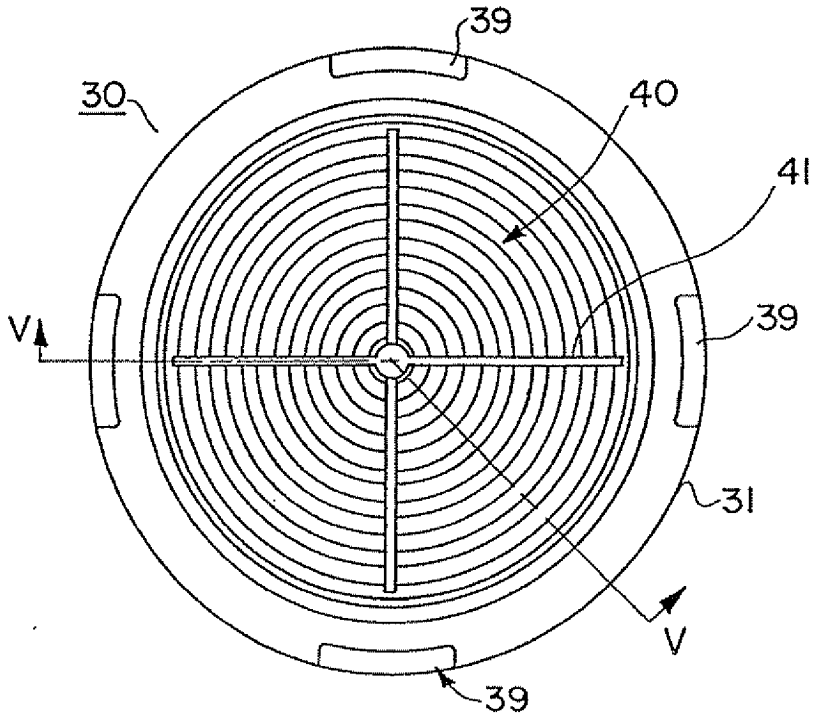


FIG. 3

FIG. 4



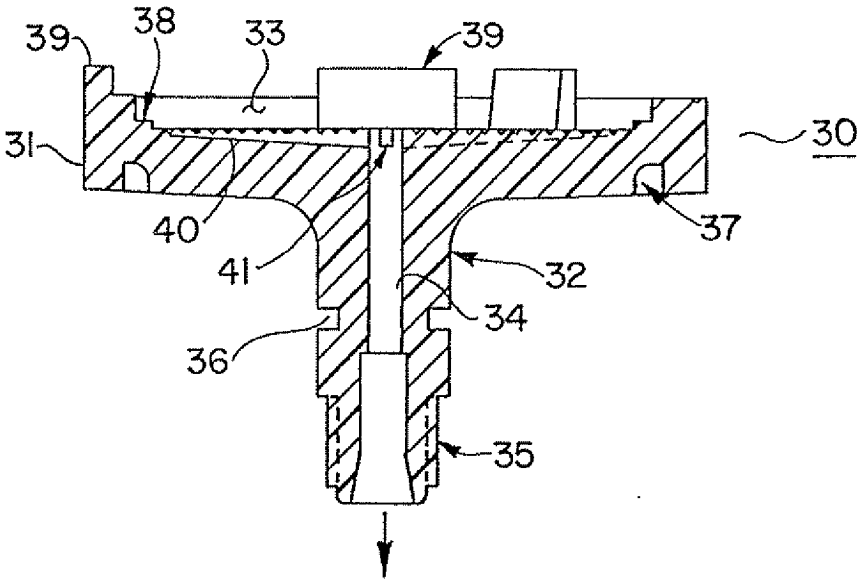


FIG. 5

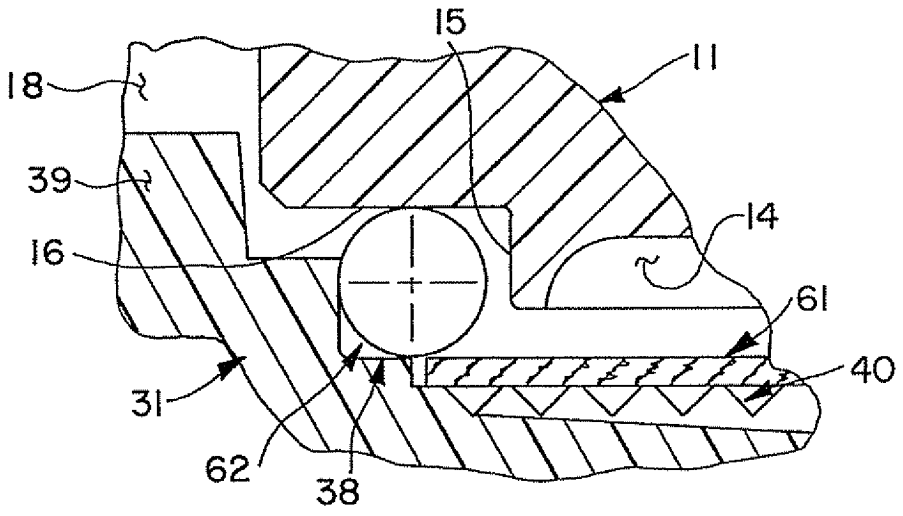


FIG. 6

FILTER FOR FILTERING AN AGGRESSIVE FLUID

This invention relates to a filter capable of filtering an aggressive fluid at a high pressure and high temperature. More particularly but not exclusively, it relates to a filter for filtering solvent-based inks used in ink jet printers.

An ink jet printer is a type of printer in which an ink is sprayed through a nozzle at a surface to be printed. In order to prevent the nozzle from becoming clogged and to assure a good print quality, it is desirable to remove agglomerated pigments, resin gels, dirt, and the like from the printing ink before it is passed through the nozzle. Accordingly, some ink jet printers are equipped with a filter connected to the upstream side of the nozzle for filtering undesirable substances from the printing ink.

Printing inks for use in ink jet printers are frequently described as "aggressive fluids", meaning that they may chemically attack materials that they contact. For example, they can cause many typical plastics to swell and/or weaken by causing a breakdown of the polymer chains comprising the plastic. Elastomeric seals are also subject to attack by the printing inks. Of course, the aggressiveness of these fluids increases as the temperature of the fluid increases.

A typical printing ink is a solvent-based ink containing a large percentage of methyl ethyl ketone (sometimes as much as 99%). During filtration, the ink is generally at a high temperature (130°F = approximately 54° C, for example) and a high

pressure (125 psig = 8.62×10^5 Pa gauge pressure, for example). Because of the aggressive nature of the ink and the severe process conditions, the materials which are suitable for use in a housing of a filter for filtering printing inks are very limited. Low cost, easily formable thermoplastics such as polypropylene, acetal, and nylon do not have adequate resistance to solvent-based inks such as inks based on methyl ethyl ketone, so a filter housing made of such materials has a short lifespan and poor reliability. Various metals, such as stainless steel, have good resistance to solvent-based inks, but the material costs and manufacturing costs of a filter housing made of such metals are prohibitive. Engineering plastics also have good resistance to solvent-based inks, but because of their high melting points, they can not be readily processed by convenient techniques such as ultrasonic welding, spin welding, and radiant heat or conduction welding. There has yet to be developed an inexpensive, reliable method of forming a filter housing from engineering plastics.

Thus, there is presently a need for a filter for solvent-based inks and other aggressive fluids which has good durability and can be inexpensively manufactured.

Accordingly, the present invention provides a filter for filtering an aggressive fluid comprising: a housing including an inlet, an outlet, and first and second housing sections combined to form a chamber communicating with the inlet and the outlet; a filter element for filtering the aggressive fluid disposed inside the chamber; a seal member forming a fluid-tight seal between the housing sections; and an overmold formed around the first and second

housing sections and isolated from the chamber by the seal member.

The present invention also provides a filter comprising a housing including an inlet, an outlet, and first and second housing sections combined to form a chamber communicating with the inlet and the outlet; a filter element having a periphery and disposed inside the chamber; and an elastomeric seal member in sealing contact with the first and second housing sections to prevent fluid from leaking from the housing and in sealing contact with the filter element to prevent fluid from bypassing the filter element.

The present invention further provides a method of manufacturing a filter comprising: disposing a filter element in a chamber defined by a first housing section and a second housing section; disposing an elastomeric seal between the housing sections along a periphery of the filter element; and forming an overmold around the housing sections while urging the housing sections towards one another to compress the seal member into a compressed state and create sealing contact between the seal member and the housing sections.

The present invention additionally provides a method of manufacturing a filter comprising: another form of the present invention comprises disposing a filter element and an elastomeric seal in a chamber defined by a first housing section and second housing section with the elastomeric seal disposed along a periphery of the filter element and contacting a surface of the first housing section; and urging the housing sections towards one another to press the elastomeric seal into sealing contact with the surface of the first housing section, with

a surface of the second housing section, and with a surface of the filter element.

Some filters embodying the present invention are especially suitable for filtering an aggressive fluid such as a solvent-based printing ink containing a large percentage of methyl ethyl ketone, although the filters are not restricted to use with any particular fluid. Some of the methods embodying the present invention provide filters which are sufficiently compact to fit inside an ink jet printer.

More generally, embodiments of the present invention provide filters which are easily and inexpensively manufactured, which are both reliable and durable, and which may be disposable.

Preferred embodiments of the present invention will now be described while referring to the accompanying drawings, in which:

Figure 1 is a longitudinal cross-sectional view of an embodiment of a filter according to the present invention;

Figure 2 is a plan view of the inlet housing section of Figure 1;

Figure 3 is a cross-sectional view taken along Line III-III of Figure 2;

Figure 4 is a plan view of the outlet housing section of Figure 1;

Figure 5 is a cross-sectional view taken along Line V-V of Figure 4; and

Figure 6 is an enlarged view of a portion of the seal member and the housing sections of Figure 1, showing the seal member in its uncompressed state.

Reference will first be made to Figure 1, which is a longitudinal cross-sectional view of a

preferred embodiment. The embodiment includes a housing having an inlet housing section 10 and an outlet housing section 30 combined together to define a chamber 60. The two housing sections are secured to each other by a securing member in the form of an overmold 50. A filter element 61 for filtering an aggressive fluid is disposed inside the chamber 60 of the housing. A seal member 62 forms a fluid-tight seal between the housing sections 10 and 30 along the periphery of the filter element 61 and prevents fluid from leaking to the outside of the chamber 60. The housing sections and the seal member 62 are formed of materials which are resistant to the aggressive fluid being filtered, but since the securing member is disposed outside the periphery of the seal member 62, it can be made of a material which is not resistant to the aggressive fluid.

In the present embodiment, the inlet and outlet housing sections 10 and 30 both have a circular shape as viewed in plan. However, the shape of the housing sections is not important as long as they together define a chamber 60 for the filter element 61 and inlet and outlet ports to enable a fluid to pass through the chamber 60. The arrows in Figure 1 indicate the normal direction of fluid flow through the filter.

The structure of the inlet housing section 10 in this embodiment is best shown in Figures 2 and 3, which are respectively a plan view and a cross-sectional view taken along Line III-III of Figure 2. The inlet housing section 10 has a disk-shaped base 11 and an inlet pipe 12 extending from one of its surfaces. The surface of the base 11 from which the inlet pipe 12 extends will be

referred to as the outer surface of the base 11, and the surface which opposes the outlet housing section 30 will be referred to as the inner surface of the base 11. Preferably, the base 11 and the inlet pipe 12 are integrally molded to simplify manufacture. The inlet pipe 12 has a central inlet passage 13 communicating between an upstream end of the inlet pipe 12 and a cavity 14 formed in the inner surface of the base 11. The outer periphery of the cavity 14 is defined by an annular flange 15 extending from the inner surface of the base 11. The portion of the inner surface adjoining the flange 15 on the radial outer side of the flange 15 forms a sealing surface 16 which is in sealing contact with the seal member 62 during operation of the filter. An annular recess 17 for mating with a corresponding flange 54 on the overmold 50 is formed in the outer surface of the base 11 surrounding the inlet pipe 12.

In order to prevent relative rotation of the inlet and outlet housing sections 10 and 30 after they are assembled, the inlet housing section 10 is preferably formed with an engaging portion which engages with a corresponding engaging portion of the outlet housing section 30. In the present embodiment, the engaging portion of the inlet housing section 10 comprises a plurality of slots 18 formed in the outer periphery of the base 11.

The inlet pipe 12 is preferably equipped with means for enabling the inlet pipe 12 to be easily connected to a hose, a pipe, or other conduit for the fluid to be filtered. In this embodiment, the inlet pipe 12 has an integrally molded tube union connector 19 formed on it, although the inlet pipe 12 can be shaped to be used with another type of

connector, such as a hose barb connector, a pipe thread connector, or a tri-clover connector. Alternatively, the inlet pipe 12 can be formed with a smooth outer surface.

Figures 4 and 5 illustrate the structure of the outlet housing section 30 in detail, Figure 4 being a plan view and Figure 5 a cross-sectional view along Line V-V of Figure 4. The outlet housing section 30 is similar in its overall structure to the inlet housing section 10, and it includes a disc-shaped base 31 and an outlet pipe 32 extending from a surface of the base 31. The surface of the base 31 on which the outlet pipe 32 is formed will be referred to as the outer surface of the base 31, and the other surface will be referred to as the inner surface. Preferably, for ease of manufacture, the outlet pipe 32 and the base 31 are integrally molded. An annular recess 33 for receiving the filter element 61 and the seal member 62 is formed in the inner surface of the base 31, and an outlet passage 34 extends through the outlet pipe 32 between the recess 33 and the downstream end (the lower end in Figure 5) of the outlet pipe 32. Like the inlet pipe 12, the outlet pipe 32 can have an integrally molded connector 35, such as a tube union connector, formed on its downstream end. A circumferentially-extending groove 36 for receiving a retaining ring or other device to support mounting or installation of the filter may also be formed on the outlet pipe 32. Although not shown, a similar groove may be formed on the inlet pipe 12.

An annular recess 37 is formed in the outer surface of the base 31. When the filter is assembled, the recess 37 engages with a corresponding flange 55 of the overmold 50. The

annular recess 37 in the outlet housing section 30 and the annular recess 17 in the inlet housing section 10 may be disposed at equal or unequal radial distances from the center of the housing.

The recess 33 for the filter element 61 has a substantially flat bottom surface for supporting the filter element 61. Preferably, the base 31 includes means for positioning the filter element 61 and the seal member 62 inside the recess 33. In the present embodiment, the positioning means comprises a step 38 extending circumferentially around the recess 33. The inner diameter of the step 38 is preferably slightly larger than the diameter of the filter element 61, and the height of the step 38 is preferably close to the thickness of the filter element 61 in an uncompressed state. The top surface of the step 38 acts as a sealing surface which supports the seal member 62 and which is in sealing contact with the seal member 62 during operation of the filter.

Engaging portions in the form of a plurality of projections 39 are formed in the outer surface of the base 31 in locations corresponding to the locations of the slots 18 in the base 11 of the inlet housing section 10. When the two housing sections are combined together, the projections 39 fit into the slots 18 and prevent relative rotation of the housing sections. The slots 18 and the projections 39 together comprise rotation preventing means for preventing relative rotation of the housing sections. The purpose of the rotation preventing means is to resist rotational forces exerted on the housing sections, especially during assembly and overmolding, which would otherwise be transmitted to the seal member 62 and the filter

element 61, which could be damaged by such forces. The rotation preventing means need not have any particular structure. For example, slots could be formed in the outlet housing section 30 and projections in the inlet housing section 10 instead of vice versa, or the rotation preventing means could comprise engaging sets of teeth, pins which fit into corresponding holes, or the like. It is also possible to omit the rotation preventing means.

The inner surface of the base 31 is preferably equipped with drainage means for enabling filtrate passing through the filter element 61 to easily drain to the outlet passage 34 in the outlet pipe 32. In the present embodiment, the outlet means comprises a plurality of circumferential grooves 40 formed in the bottom surface of the recess 33 and a plurality of channels 41 extending generally radially outward from the outlet passage 34 and intersecting the circumferential grooves 40, each of the channels 41 having an inner end communicating with the outlet passage 34. Preferably, the cross-sectional area of each channel 41 perpendicular to the direction of flow through the channel 41 increases towards the center of the base 31. In the present embodiment, the channels 41 are sloped with respect to the bottom surface of the recess 33 and become deeper as they approach the outlet passage 34. Sloping the channels 41 improves the drainage properties, but it is not necessary for them to be sloped. The channels 41 are illustrated as being straight and of constant width, but they may be arcuate, branched, or of other shape, and their width may vary along their length. The grooves 40 and the channels 41 are preferably integrally formed with the rest of the base 31 at

the time of molding.

Other means can be used to allow drainage of filtrate to the outlet passage 34. For example, the bottom surface of the recess 33 could be smooth, and a support screen comprising a stiff plastic or metal mesh could be disposed in the recess 33 to permit drainage by preventing the filter element 61 from contacting the bottom surface of the recess 33. Such a support screen could also be used in conjunction with the grooves 40 and channels 41.

The structure of the inlet and outlet of the filter is not critical, and they need not be in the form of an inlet pipe 12 and an outlet pipe 32. For example, the inlet and outlet could be in the form of threaded holes into which external connectors are inserted. Furthermore, as long as the filter element 61 is disposed in a flow path between the inlet and outlet, it is possible for both the inlet and the outlet to be formed in a single one of the housing sections.

Although injection molding is generally the most economical method of forming the housing sections, any method that is applicable to the materials used for the housing sections can be employed, such as machining, casting, and rotational molding.

The inlet and outlet housing sections can be made of any material having good resistance to the aggressive fluid being filtered. Metals can be used. However, since the purpose of the present invention is to minimize material costs and manufacturing costs and provide an economical, disposable filter, the housing sections are preferably made of a plastic material. When the aggressive fluid is a printing ink comprising a

large proportion of methyl ethyl ketone, an example of a particularly suitable material for the housing sections is glass-filled polyphenylene sulfide. Polyphenylene sulfide is a high-performance crystalline engineering plastic that has good processibility, high chemical resistance, and excellent thermal and mechanical properties. It is especially suitable for injection molding, which enables the housing sections to each be formed as integral members. A glass filling in not essential but helps to increase the bending strength of the resulting molding.

Other suitable plastic materials which can be used with aggressive fluids such as printing ink include polytetrafluoroethylene (PTFE), perfluoroalkoxy (PFA), perfluoro ethylene propylene (FEP), polyvinylidene difluoride (PVDF), and polyether ether ketone (PEEK). PTFE, PFA, and FEP are particularly suitable when filtering a fluid such as hot sulfuric acid.

When the fluid being filtered contains a large percentage of methyl ethyl ketone, materials such as polypropylene, glass- filled nylon 66, and glass-filled acetal are inferior to glass- filled polyphenylene sulfide for use in the housing sections. Polypropylene has a low resistance to methyl ethyl ketone and therefore is not compatible with aggressive printing inks. Glass-filled nylon 66 has good compatibility with aggressive solvents such as methyl ethyl ketone, but housing sections made of glass-filled nylon 66 tend to absorb methyl ethyl ketone. After exposure for 3 days at 155° F (68.3 °C) and 200 psig (1.379×10^6 Pa gauge pressure), housing sections made of glass filled nylon 66 lose significant mechanical strength and

are therefore unacceptable. Glass-filled acetal was found to have inadequate bending strength.

However, when the filter is being used to filter fluids less aggressive than methyl ethyl ketone, materials such as polypropylene, glass-filled nylon 66, and glass-filled acetal may be successfully employed for the housing sections.

The cavity 14 of the inlet housing section 10 and the recess 33 in the outlet housing section 30 together define the chamber 60 for the filter element 61. The size and shape of the cavity 14 forming the inlet portion of the chamber 60 will be determined partly by fluid flow considerations, but preferably the cavity 14 is as small as possible to minimize hold up volume of fluid inside the chamber 60 when the filter is discarded. If the surface of the cavity 14 is close to the upstream surface of the filter element 61, the inlet housing section 10 can support and prevent damage to the filter element 61 during momentary flow reversals when fluid flows in the direction opposite to that shown by the arrows in Figure 1. The cavity 14 is illustrated as having a smooth surface, but it could instead be formed with grooves or channels similar to those formed in the recess 33 of the outlet housing section 30. A support screen made of a stiff plastic or metal mesh, sheet, or grid could also be incorporated into the cavity 14.

The material of which the filter element 61 is formed and its filtering characteristics can be selected on the basis of the fluid being filtered and filtering parameters, such as the flow rate and removal rating. Preferably the filter element 61 is compatible with the fluid being filtered so that the filter element 61 will have as long a lifespan as

possible. An example of a suitable filter element 61 for filtering a printing ink containing a large percentage of methyl ethyl ketone is an acrylic epoxy bonded glass fiber matrix cast on a cellulose substrate, which is available from Pallflex Corporation under the trade designation Ultipor II. The shape of the filter element 61 is not critical. In the present embodiment, it is substantially disc-shaped, but it could instead be polygonal or some other shape.

It is possible to attach the filter element 61 to one of the housing sections by a means such as a bonding agent, but this is not necessary in the illustrated embodiments because the filter element 61 is held in place inside the chamber 60 by the flange 15 of the inlet housing section 10 and by the seal member 62.

The seal member 62 can be any means capable of forming a fluid-tight seal around the periphery of the filter element 61 so as to prevent the fluid being filtered from leaking to the outside of the housing sections. Preferably, the seal member 62 is made from an elastomeric material having compatibility with the fluid being filtered, since the seal member 62 is partially in contact with the fluid. Some examples of elastomeric materials which are compatible with aggressive fluids such as printing ink containing a large proportion of methyl ethyl ketone are ethylene propylene, butyl, or any PTFE, PFA, of FEP encapsulated elastomer.

In order to obtain a reliable seal, the seal member 62 is preferably in sealing contact with surfaces of both the inlet housing section 10 and the outlet housing section 30. Sealing contact refers to contact that substantially prevents

passage of fluid past the region of contact. Preferably, the seal member 62 is also in contact with the filter element 61, most preferably, the upstream surface of the filter element 61. The seal member 62 has an uncompressed state which it assumes when the filter is partially assembled and a compressed state when the filter is completely assembled. In the uncompressed state, the seal member 62 lightly contacts at least the sealing surfaces of both housing sections but need not be in sealing contact. In the compressed state, the seal member 62 is deformed to come into sealing contact with the sealing surfaces of both housing sections and at the same time preferably also contacts the upstream surface of the filter element 61.

Figure 6 is an enlarged view of a portion of the seal member 62 of this embodiment in its uncompressed state. In this embodiment, the seal member 62 is an O-ring having a circular cross section, although the cross-sectional shape is not important. The seal member 62 rests on the step 38 of the outlet housing section 30. The center of the cross-sectional area of the O-ring preferably lies outside the outer periphery of the filter element 61. When the housing sections are urged towards one another from the state shown in Figure 6, the O-ring is compressed by the sealing surfaces of the housing sections and is deformed as shown in Figure 1 into the compressed state so as to sealingly contact the upstream surface along the periphery of the filter element 61. Thus, the compressed O-ring serves (1) to seal the inlet and outlet housing sections 10, 30 and prevent the fluid from leaking from the housing, (2) to seal the upstream surface from the downstream surface of the filter element 61 and prevent bypass

of the fluid around the filter element 61, and (3) to secure the filter element 61 in place within the housing and restrain the filter element 61 from moving within the housing. When the O-ring is in the compressed state, the flange 15 of the inlet housing section 10 helps restrain the O-ring.

As shown in Figure 6, the radially inner surface of the projections 39 on the outlet housing section 30 may be sloped with respect to the base 31, and the edges of the slots 18 in the inlet housing section 10 may be chamfered to make it easier for the projections 39 to engage the slots 18 during assembly of the housing sections.

As shown in Figure 1, the inner surface of the base 11 of the inlet housing section 10 preferably contacts the inner surface of the base 31 of the outlet housing section 30 when the seal member 62 is in its compressed state. This contact prevents the O-ring from extruding between the inlet and outlet housing sections 10, 30 when the pressure of the fluid inside the housing greatly exceeds the pressure outside the housing.

Many engineering plastics, especially glass-filled engineering plastics, have high melting points. Consequently, when the housing sections are made of an engineering plastic such as glass-filled polyphenylene sulfide, they can not be joined to one another by methods such as ultrasonic welding or spin welding which can be employed with polypropylene or other thermoplastics having lower melting points. Therefore, in the present embodiment, the housing sections are mechanically clamped together by securing means comprising the overmold 50. The overmold 50 is a molding formed around the assembled housing sections by injection

molding or other suitable molding technique. The overmold 50 need not have any particular shape, but in the present embodiment, to minimize its size, it has an annular shape generally corresponding to the outer shape of the housing sections. It comprises a tubular outer wall 51, a disk-shaped inlet-side surface 52, and a disk-shaped outlet-side surface 53, all of which are integrally formed with one another. An engaging member in the form of an annular flange 54 extends inward from the inlet-side surface 52 and mates with the annular recess 17 in the outer surface of the base 11 of the inlet housing section 10. A similar annular flange 55 extends inward from the outlet-side surface 53 and mates with the annular recess 37 in the outer surface of the base 31 of the outlet housing section 30. In the illustrated embodiment, the inner diameter of the inlet-side surface 52 of the overmold 50 is preferably smaller than the inner diameter of the outlet-side surface 53. This allows the base 11 to be thicker in the vicinity of the seal 62 and therefore to provide better support against the forces exerted by the seal 62. The engagement between the flanges of the overmold 50 and the recesses in the housing sections prevents the housing sections from slipping with respect to one another during molding and increases the strength of the filter. Alternatively, the outer surfaces of the housing sections could have projections formed thereon, and the overmold 50 could be molded over the projections to achieve engagement between the overmold 50 and the housing sections.

Means other than the recesses and flanges of the illustrated embodiment could be employed to

prevent the relative movement of the housing sections. For example, the bases of both housing sections could be formed with through holes extending through the depth of the bases, and during overmolding, the through holes could be filled with molten plastic to form pins integral with the overmolding. Upon cooling, the pins would prevent relative movement of the housing sections.

The thickness of the overmold 50 can be selected based on strength considerations. The overmold 50 must be strong enough to keep the seal member 62 in a compressed state and to resist the fluid pressure inside the filter during normal operation, i.e., to maintain the inlet and outlet housing sections 10, 30 clamped together up to a predetermined design pressure. The overmold 50 can be formed so as to have any desired thickness, either by use of a single overmold, or by forming multiple overmolds, one atop another, until the desired thickness is reached.

Preferably, the overmold 50 is isolated from the chamber 60 by the seal member 62, so that no portion of the overmold 50 contacts the fluid which is being filtered. Namely, the overmold 50 serves primarily to exert a compressive force on the housing sections and the seal member 62 and does not itself perform a sealing function. Accordingly, the overmold 50 can be formed from any material having adequate strength and formability, and need not be compatible with the fluid being filtered. Thus, a wide range of materials can be employed for the overmold 50. A few examples of suitable materials for the overmold 50 are inexpensive thermoplastics such as polypropylene, nylon, or acetal, with or without a glass filling.

Means other than an overmold can be used for connecting the housing sections to each other. For example, the housing sections could be secured to one another by screws passing through the housing sections outside the periphery of the filter element 61, or by a two-piece container comprising a top and a bottom which fit around the housing sections and are screwed together to urge the housing sections towards one another. However, an overmold is superior to such connecting methods with respect to material costs, labor costs, and manufacturing efficiency and therefore is more suitable for mass production.

An example of an assembly method for the illustrated embodiment is as follows. The outlet housing section 30 is placed into a mold half for overmolding, and the filter element 61 and the seal member 62 are placed inside the recess 33 of the outlet housing section 30, either manually or by machine. The filter element 61 may be but is preferably not bonded to the inner surface of the outlet housing section 30. The inlet housing section 10 is then placed over the outlet housing section 30, with the projections 39 of the outlet housing section 30 fitting into the slots 18 of the inlet housing section 10. Since the housing sections in this embodiment are symmetric about a central axis, it does not matter which projection 39 fits into which slot 18. In this state, the housing sections appear as shown in Figure 6, with the sealing surfaces lightly contacting the seal member 62. The mold is then closed, and the mold halves urge the housing sections towards one another to deform the seal member 62 into its compressed state. In its compressed state, the seal member 62 secures

the filter element 61 in position within the housing, seals the upstream surface of the filter element 61 from the downstream surface, and seals the inlet and outlet housing sections 10, 30. With the mold closed, a liquid mold material is injected into the mold cavity surrounding the housing sections to form the overmold 50. The overmold 50 is allowed to cool, the mold is then opened, and the assembled filter is removed from the mold. When the overmold 50 has cooled, it securely holds the housing sections together with the seal member 62 in its compressed state. The filter is then ready for installation in a printer or other apparatus in which it is to be used.

When used in an ink jet printer, the filter is connected between a printing nozzle and an ink sump to remove contaminants from ink which could clog the nozzle. The integral connectors 19 and 35 on the inlet and outlet pipes enable the filter to be easily connected to suitable ink supply lines. When the build-up of contaminants on the filter element 61 reaches a certain level after a long period of use, the entire filter can be discarded and replaced with a new filter.

As the housing sections and the overmold 50 can all be formed by injection molding of inexpensive materials, the manufacturing costs and material costs of a filter according to the present invention are low. Therefore, a filter according to the present invention is particularly suitable for use as a disposable filter.

CLAIMS

1. A filter for filtering an aggressive fluid comprising:

a housing including an inlet, an outlet, and first and second housing sections combined to form a chamber communicating with the inlet and the outlet;

a filter element for filtering the aggressive fluid disposed inside the chamber;

a seal member forming a fluid-tight seal between the housing sections; and

an overmold formed around the first and second housing sections and isolated from the chamber by the seal member.

2. A filter as claimed in claim 1 wherein the housing sections comprise a first plastic material and the overmolding comprises a second, different plastic material not resistant to the aggressive fluid.

3. A filter as claimed in claim 1 or 2 wherein the housing sections comprise polyphenylene sulfide.

4. A filter as claimed in claim 1 or 2 wherein the housing sections comprise at least one of polyphenylene sulfide, PTFE, PFA, FEP, PVDF, and PEEK.

5. A filter as claimed in any preceding claim further comprising rotation preventing means for preventing relative rotation of the housing sections.

6. A filter as claimed in claim 5 wherein the

rotation preventing means comprises a projection formed on the first housing section and a recess formed in the second housing section for receiving the projection.

7. A filter as claimed in any preceding claim wherein the overmold includes an engaging portion which engages with a corresponding engaging portion in the housing.

8. A filter as claimed in claim 7 wherein the engaging portion in the housing comprises a recess formed in an outer surface of one of the housing sections, and the engaging portion in the overmold comprises a flange mating with the recess.

9. A filter as claimed in any preceding claim further comprising drainage and support means formed in one of the housing sections to allow drainage of filtrate to the outlet.

10. A filter as claimed in claim 9 wherein the drainage and support means comprises a plurality of drainage grooves formed in a surface of one of the housing sections surrounding the outlet and a drainage channel extending outward from the outlet and intersecting the drainage grooves.

11. A filter as claimed in claim 10 wherein the cross-sectional area of the drainage channel increases towards the outlet.

12. A filter as claimed in any preceding claim wherein the seal member comprises an elastomeric O-ring having a cross-sectional center disposed

outside the periphery of the filter element when the O-ring is in an uncompressed state.

13. A filter as claimed in any preceding claim wherein the housing includes means for restraining the filter element from movement.

14. A filter as claimed in claim 13 wherein the means for restraining the filter element comprises the seal member.

15. A filter comprising:

a housing including an inlet, an outlet, and first and second housing sections combined to form a chamber communicating with the inlet and the outlet;

a filter element having a periphery and disposed inside the chamber; and

an elastomeric seal member in sealing contact with the first and second housing sections to prevent fluid from leaking from the housing and in sealing contact with the filter element to prevent fluid from bypassing the filter element.

16. A filter as claimed in claim 15 wherein the elastomeric seal is compressed between the first and second housing sections and the periphery of the filter element.

17. A filter as claimed in claim 15 or 16 wherein the center of the cross section of the seal member is disposed outside the periphery of the filter element when the seal member is in a non-compressed state.

18. A method of manufacturing a filter

comprising:

disposing a filter element in a chamber defined by a first housing section and a second housing section;

disposing an elastomeric seal between the housing sections along a periphery of the filter element; and

forming an overmold around the housing sections while urging the housing sections towards one another to compress the seal member into a compressed state and create sealing contact between the seal member and the housing sections.

19. A method as claimed in claim 18 wherein the overmold is formed such that the strength of the overmold in a cooled state is sufficient both to maintain the seal member in a compressed state and to maintain the first and second housing sections clamped together during normal operation.

20. A method of manufacturing a filter comprising:

disposing a filter element and an elastomeric seal in a chamber defined by a first housing section and second housing section with the elastomeric seal disposed along a periphery of the filter element and contacting a surface of the first housing section; and

urging the housing sections towards one another to press the elastomeric seal into sealing contact with the surface of the first housing section, with a surface of the second housing section, and with a surface of the filter element.

21. A filter for filter an aggressive fluid

substantially as herein described with reference to and as illustrated in the accompanying drawings.

22. A method of manufacturing a filter substantially as herein described.

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Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition L) B1D (DNFB,DNMB,DNMC,DNMX)
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Databases (see over)

(i) UK Patent Office

(ii)

Date of Search: 14 MAY 1993

Documents considered relevant following a search in respect of claims 1-14,18,19,21,22

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2119273 A (GELMAN SCIENCES INC)	1,2,5,7, 9-11,13, 14,18,19
X	US 4113627 (LESSON) Figure 16	1,2,5, 7-10,13, 14,18,19

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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P: Document published on or after the declared priority date but before the filing date of the present application.

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